CLAIMS

1. A method for brain hypothermia, said method comprising, in a first phase to enable an early and fast inset of the hypothermia, the steps of:

providing a container with an infusion solution having a first temperature and a venous infusion catheter connected to an outlet of said container, said venous infusion catheter having an infusion solution lumen;

percutaneously inserting a distal end of said venous infusion catheter into a peripheral vein;

cooling the infusion solution to a second temperature lower than said first temperature; and

infusing a first amount of said cold infusion solution into said vein via the infusion solution lumen of said venous infusion catheter shortly after said cooling, to enable the cold infusion solution to cool the blood flowing to the brain while avoiding air bubbles arising in the infusion solution.

2. The method of claim 1, wherein the infusion solution is cooled to a second temperature in the range of 0 – 10 degrees Celsius.

3. The method of claim 2, wherein the infusion solution is cooled to a second temperature in the range of 0 – 4 degrees Celsius.

4. The method of claim 1, wherein the infusion catheter is inserted into a median cubital vein.

5. The method of claim 1, wherein the infusion catheter is inserted into a saphenous vein.

6. The method of claim 1, wherein the infusion solution is a hypotonic saline solution.

7. The method of claim 1, wherein said first amount of infusion solution is in the range of 1-2 litres.

8. The method of claim 1, wherein the infusion solution has a low osmolarity in order to lessen the circulatory volume load of the infusion solution when infused into the patient.

9. The method of claim 1, further comprising the step of providing the infusion solution in a container that is air-sealed at steady state at a temperature in the range of 37 degrees

Celsius.

10. The method of claim 1, further comprising the step of inhaling a controlled fraction of gas having brain protective properties.

11. The method of claim 1, further comprising a second hypothermia phase for brain-selective hypothermia, wherein an arterial infusion catheter is inserted into an artery and a second amount of cold solution is infused into the arterial system, to enable a more efficient temperature regulation of the brain.

12. The method of claim 11, wherein the arterial infusion catheter is inserted into a selected peripheral artery.

13. The method of claim 12, wherein the arterial infusion catheter is inserted into an arteria radialis.

14. The method of claim 12, wherein the arterial infusion catheter is inserted into an arteria brachialis.

15. The method of claim 11, further comprising the step of positioning a distal tip of said arterial infusion catheter in a selected central artery at the vicinity of a branch artery supplying blood to the brain.

16. The method of claim 15, wherein said selected central artery is arteria subclavia at the vicinity of arteria carotis.

17. The method of claim 15, wherein said selected central artery is truncus brachiocephalica.

18. The method of claim 15, wherein said selected central artery is ascending aorta.

19. The method of claim 12, further comprising the step of applying a pressure from the outside of the extremity with the peripheral artery for decreasing peripheral blood circulation.

20. The method of claim 11, further comprising the steps of:

percutaneously inserting a temperature sensor in a blood vessel draining blood from the brain;

sensing the temperature in the blood of said blood vessel thus providing an

indication of the temperature in the brain;

adjusting the infusion rate dependent on said sensed temperature for achieving a desired temperature in the brain.

21. The method of claim 1, further comprising a third hypothermia phase for maintained hypothermia, comprising the steps of:

inserting into a blood vessel an extraction catheter for extraction of blood;

inserting an arterial infusion catheter in the vicinity of an artery supplying blood to the brain;

establishing an first extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a temperature regulating device capable of cooling extracted blood;

extracting blood from said blood vessel via said extraction catheter leading a first amount of said extracted blood into said first extra-corporeal blood circuit;

cooling said first amount of said extracted blood;

infusing said cooled extracted blood to said brain supplying artery via said arterial infusion catheter;

maintaining cooling and circulation in said first extra-corporeal blood circuit for a selected period of time.

22. The method of claim 21, further comprising the steps of:

inserting a venous infusion catheter into a vein of the venous system;

establishing a second extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

leading a second amount of said extracted blood from said blood vessel via said extraction catheter into said second extra-corporeal blood circuit;

heating said second amount of said extracted blood;

infusing said heated second amount of extracted blood to said venous system via said venous infusion catheter;

maintaining heating and circulation in said second extra-corporeal blood circuit for a selected period of time.

23. The method of claim 22, further comprising the steps of:

percutaneously inserting a temperature sensor in a blood vessel draining blood from the brain;

sensing the temperature in the blood of said blood vessel thus providing an indication of the temperature in the brain;

adjusting the infusion rate of said cooled blood dependent on said sensed

temperature for achieving a desired temperature in the brain.

24. The method of claim 22, further comprising the steps of:

percutaneously inserting a temperature sensor in a blood vessel draining blood from the brain;

sensing the temperature in the blood of said blood vessel thus providing an indication of the temperature in the brain;

adjusting the temperature of said cooled blood dependent on said sensed temperature for achieving a desired temperature in the brain.

25. The method of claim 21, wherein:

said arterial infusion catheter is a double lumen catheter having a first lumen for infusing cooled blood through a plurality of openings at the distal end of said catheter and a second lumen for infusing a substance through an opening at the distal tip of said catheter;

said distal end of said infusion catheter is positioned in ascending aorta such that said plurality of openings of said first lumen are arranged at level with the brachiocephalic artery and the left carotid artery; and

said opening of said distal tip is positioned at the entrance of the coronary artery.

26. The method of claim 11, further comprising a third hypothermia phase for maintained hypothermia, comprising the steps of:

inserting into a blood vessel an extraction catheter for extraction of blood;

inserting an arterial infusion catheter in the vicinity of an artery supplying blood to the brain;

establishing a first extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a temperature regulating device capable of cooling extracted blood;

extracting blood from said blood vessel via said extraction catheter leading a first amount of said extracted blood into said first extra-corporeal blood circuit;

cooling said first amount of said extracted blood;

infusing said cooled extracted blood to said brain supplying artery via said arterial infusion catheter;

maintaining cooling and circulation in said first extra-corporeal blood circuit for a selected period of time.

27. The method of claim 26, further comprising the steps of:

inserting a venous infusion catheter into a vein of the venous system;

establishing a second extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

leading a second amount of said extracted blood from said blood vessel via said extraction catheter into said second extra-corporeal blood circuit;

heating said second amount of said extracted blood;

infusing said heated second amount of extracted blood to said venous system via said venous infusion catheter;

maintaining heating and circulation in said second extra-corporeal blood circuit for a selected period of time.

28. A method for brain hypothermia comprising, to enable a brain-selective hypothermia, the steps of:

providing a container with an infusion solution having a first temperature and an arterial infusion catheter connected to an outlet of said container, said arterial infusion catheter having an infusion solution lumen;

percutaneously inserting a distal end of said arterial infusion catheter into an artery in the vicinity of a branch artery supplying blood to the brain;

cooling the infusion solution to a second temperature lower than said first temperature; and

infusing an amount of said cold infusion solution into said artery via the infusion solution lumen of said arterial infusion catheter shortly after said cooling, to enable the cold infusion solution to cool the blood flowing to the brain while avoiding air bubbles arising in the infusion solution and an efficient temperature regulation of the brain.

29. A method for brain hypothermia comprising, to enable a maintained hypothermia, the steps of:

inserting into a blood vessel an extraction catheter for extraction of blood;

inserting an arterial infusion catheter in the vicinity of an artery supplying blood to the brain;

establishing an second extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a cooling device capable of cooling extracted blood;

inserting a venous infusion catheter into a vein of the venous system;

establishing a first extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

extracting blood from said blood vessel via said extraction catheter into said

first and second extra-corporeal blood circuit;

cooling a second amount of said extracted blood;

infusing said cooled second amount of extracted blood to said brain supplying artery via said arterial infusion catheter;

heating a first amount of said extracted blood;

infusing said heated first amount of extracted blood to said venous system via said venous infusion catheter.

30. A method for brain hypothermia, said method comprising the steps of:

providing a container with a cold infusion solution and an infusion catheter connected to an outlet of said container, said infusion catheter having an infusion solution lumen;

percutaneously inserting a distal end of said infusion catheter into a blood vessel that supplies the brain with blood;

infusing the cold infusion solution into said blood vessel, to enable the cold infusion solution to flow distally to the brain.

31. A method of achieving thermal regulation of a selected brain hemisphere, said method comprising:

infusing a solution having a first predetermined temperature into a blood vessel supplying said brain hemisphere with blood until said brain hemisphere has reached a predetermined temperature or a predetermined maximum amount of solution has been infused.

32. The method as recited in claim 31, wherein the infusion solution has a predetermined temperature in the range of 0-4 degrees Celsius.

33. The method as recited in claim 31, further comprising the step of:
after the infusion step,
- establishing an extra-corporeal blood circuit;
- drawing off blood from the patient in said extra-corporeal circuit;
- regulating the temperature of said blood to a selectable temperature; and
- returning said temperature regulated blood to the patient.

34. An equipment for brain hypothermia in a living being, said equipment comprising:
- a container of infusion solution;
- a temperature regulating apparatus for said infusion solution;
- a flexible elongated infusion catheter, said catheter having a proximal end being attachable to an outlet of said container, said catheter having a sufficiently small

diameter to be percutaneously insertable into a blood vessel feeding the brain with blood.

35. An equipment for brain hypothermia, said equipment comprising, to enable an early and fast inset of the hypothermia:

a container with an infusion solution having a first temperature and a venous infusion catheter being connectable to an outlet of said container, said venous infusion catheter having an infusion solution lumen;

said venous infusion catheter having a distal end devised to be percutaneously inserted into a peripheral vein;

a cooling device being configured for cooling the infusion solution to a second temperature lower than said first temperature.

36. The equipment of claim 35, wherein the cooling device is configured for cooling the infusion solution to a second temperature in the range of 0 – 10 degrees Celsius.

37. The equipment of claim 36, wherein the cooling device is configured for cooling the infusion solution to a second temperature in the range of 0 – 4 degrees Celsius.

38. The equipment of claim 35, wherein the infusion catheter is configured to be inserted into a median cubital vein.

39. The equipment of claim 35, wherein the infusion catheter is configured to be inserted into a saphenous vein.

40. The equipment of claim 35, wherein the infusion solution is a hypotonic saline solution.

41. The equipment of claim 35, wherein said first amount of infusion solution is in the range of 1-2 litres.

42. The equipment of claim 35, wherein the infusion solution has a low osmolarity in order to lessen the circulatory volume load of the infusion solution when infused into the patient.

43. The equipment of claim 35, wherein the infusion solution is provided in a container that is air-sealed at steady state at a temperature in the range of 37 degrees Celsius.

44. The equipment of claim 35, further comprising a container with gas having brain protective properties and equipment for inhaling a controlled fraction of said gas.

45. The equipment of claim 35, further comprising an arterial infusion catheter configured to be inserted into an artery and a container with a second amount of cold solution configured to be infused into the arterial system, to enable a more efficient temperature regulation of the brain in a second hypothermia phase for brain-selective hypothermia.

46. The equipment of claim 45, wherein the arterial infusion catheter is configured to be inserted into a selected peripheral artery.

47. The equipment of claim 46, wherein the arterial infusion catheter is configured to be inserted into an arteria radialis.

48. The equipment of claim 46, wherein the arterial infusion catheter is configured to be inserted into an arteria brachialis.

49. The equipment of claim 45, wherein said arterial infusion catheter further is configured to the positioning of a distal tip of said arterial infusion catheter in a selected central artery at the vicinity of a branch artery supplying blood to the brain.

50. The equipment of claim 49, wherein said selected central artery is arteria subclavia at the vicinity of arteria carotis.

51. The equipment of claim 49, wherein said selected central artery is truncus brachiocephalica.

52. The equipment of claim 49, wherein said selected central artery is ascending aorta.

53. The equipment of claim 46, further comprising a device for applying a pressure from the outside of the extremity with the peripheral artery for decreasing peripheral blood circulation.

54. The equipment of claim 45, further comprising:

a temperature sensor configured to be percutaneously inserted in a blood vessel draining blood from the brain;

and being configured to:

sensing the temperature in the blood of said blood vessel thus providing an indication of the temperature in the brain; and

adjusting the infusion rate dependent on said sensed temperature for achieving a desired temperature in the brain.

55. The equipment of claim 35, further, for a third hypothermia phase for maintained hypothermia, comprising:

an extraction catheter being configured to be inserted into a blood vessel for extraction of blood;

an arterial infusion catheter being configured to be inserted into the vicinity of an artery supplying blood to the brain;

coupling means for establishing an first extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a temperature regulating device capable of cooling extracted blood;

and being configured to:

extracting blood from said blood vessel via said extraction catheter leading a first amount of said extracted blood into said first extra-corporeal blood circuit;

cooling said first amount of said extracted blood;

infusing said cooled extracted blood to said brain supplying artery via said arterial infusion catheter;

maintaining cooling and circulation in said first extra-corporeal blood circuit for a selected period of time.

56. The equipment of claim 55, further comprising:

a venous infusion catheter being configured to be inserted into a vein of the venous system;

and further being configured to:

establishing a second extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

leading a second amount of said extracted blood from said blood vessel via said extraction catheter into said second extra-corporeal blood circuit;

heating said second amount of said extracted blood;

infusing said heated second amount of extracted blood to said venous system via said venous infusion catheter;

maintaining heating and circulation in said second extra-corporeal blood circuit for a selected period of time.

57. The equipment of claim 56, further comprising:

a temperature sensor being configured to be percutaneously inserted in a

blood vessel draining blood from the brain;

and being configured to:

sensing the temperature in the blood of said blood vessel thus providing an indication of the temperature in the brain;

adjusting the infusion rate of said cooled blood dependent on said sensed temperature for achieving a desired temperature in the brain.

58. The equipment of claim 56, further comprising:

a temperature sensor being configured to be percutaneously inserted in a blood vessel draining blood from the brain;

and being configured to:

sensing the temperature in the blood of said blood vessel thus providing an indication of the temperature in the brain;

adjusting the temperature of said cooled blood dependent on said sensed temperature for achieving a desired temperature in the brain.

59. The equipment of claim 55, wherein:

said arterial infusion catheter is a double lumen catheter having a first lumen for infusing cooled blood through a plurality of openings at the distal end of said catheter and a second lumen for infusing a substance through an opening at the distal tip of said catheter;

said distal end of said infusion catheter is positioned in ascending aorta such that said plurality of openings of said first lumen are arranged at level with the brachiocephalic artery and the left carotid artery; and

said opening of said distal tip is positioned at the entrance of the coronary artery.

60. The equipment of claim 45, further comprising:

an extraction catheter being configured to be inserted into a blood vessel for extraction of blood;

an arterial infusion catheter being configured to be inserted into an artery to the vicinity of a branch artery supplying blood to the brain;

means for establishing a first extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a temperature regulating device capable of cooling extracted blood;

means for extracting blood from said blood vessel via said extraction catheter leading a first amount of said extracted blood into said first extra-corporeal blood circuit;

a cooling device for cooling said first amount of said extracted blood;

and being configured to:

infusing said cooled extracted blood to said brain supplying artery via said arterial infusion catheter;

maintaining cooling and circulation in said first extra-corporeal blood circuit for a selected period of time in a third hypothermia phase for maintained hypothermia,

61. The equipment of claim 60, further comprising:

a venous infusion catheter being configured to be inserted into a vein of the venous system;

and being further configured to:

establishing a second extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

leading a second amount of said extracted blood from said blood vessel via said extraction catheter into said second extra-corporeal blood circuit;

heating said second amount of said extracted blood;

infusing said heated second amount of extracted blood to said venous system via said venous infusion catheter;

maintaining heating and circulation in said second extra-corporeal blood circuit for a selected period of time.

62. An equipment for brain hypothermia comprising, to enable a brain-selective hypothermia:

a container with an infusion solution having a first temperature and an arterial infusion catheter connectable to an outlet of said container, said arterial infusion catheter having an infusion solution lumen;

a distal end of said arterial infusion catheter being configured to be percutaneously inserted into an artery in the vicinity of a branch artery supplying blood to the brain;

a cooling device configured to cooling the infusion solution to a second temperature lower than said first temperature, to enable the cold infusion solution to cool the blood flowing to the brain while avoiding air bubbles arising in the infusion solution and an efficient temperature regulation of the brain.

63. An equipment for brain hypothermia comprising, to enable a maintained hypothermia:

an extraction catheter configured to be inserted into a blood vessel for extraction of blood;

an arterial infusion catheter configured to be inserted in an artery into the vicinity of an artery supplying blood to the brain;

means for establishing an second extra-corporeal blood circuit for cooled blood between said extraction catheter and said arterial infusion catheter via a pumping means and a cooling device capable of cooling extracted blood;

a venous infusion catheter being configured to be inserted into a vein of the venous system;

means for establishing a first extra-corporeal blood circuit for heated blood between said extraction catheter and said venous infusion catheter via said pumping means and a heating device capable of heating extracted blood;

means for extracting blood from said blood vessel via said extraction catheter into said first and second extra-corporeal blood circuit;

a cooling device for cooling a second amount of said extracted blood;

a heating device for heating a first amount of said extracted blood;

and being configured to:

infusing said cooled second amount of extracted blood to said brain supplying artery via said arterial infusion catheter;

infusing said heated first amount of extracted blood to said venous system via said venous infusion catheter.

64. An equipment for brain hypothermia, comprising:

a container with a cold infusion solution and an infusion catheter connectable to an outlet of said container, said infusion catheter having an infusion solution lumen;

a distal end of said infusion catheter being configured to be percutaneously inserted into a blood vessel that supplies the brain with blood;

and being configured to infusing the cold infusion solution into said blood vessel, to enable the cold infusion solution to flow distally to the brain.

65. A catheter, wherein:

the catheter is configured to assume a curvature at its distal part and having

a first lumen having a plurality of openings positioned close to a distal end of the catheter and at the outer arc of the curvature;

a second lumen having an opening at the tip of the distal end of the catheter;

a distal part of the catheter tapering from said plurality of openings to said tip of the catheter.

66. The catheter of claim 65, wherein said curvature is configured to be positioned in and fit to the shape of the aortic arch, said plurality of openings of said first lumen being positioned before the inlet of right brachiocephalic and the left carotid artery.

67. The catheter of claim 65, having an outer diameter of about 2.7 millimetres, and wherein an inner diameter of said first lumen is about 2.1 millimetres and an inner diameter of said second lumen is about 0.3 millimetres.

68. The catheter of claim 65, wherein said plurality of openings of said first lumen are arranged about 4 centimetres from the tip of the catheter, and said distal part tapers over a length of about 3 centimetres containing the second lumen.